REMARKS

Claim 62 is objected on the ground that it depends on a cancelled claim. It has been amended to depend from claim 51, which has not been cancelled. The objection is believed to have been overcome.

The indication that claims 14, 15, 35, 36 and 48-50 are allowed and that claims 3, 4, 8, 9, 18, 19, 23, 24, 31, 33, 41-44, 57-60 and 62-63 would be allowable if rewritten in independent form is noted with appreciation.

Claims 3 and 18 are indicated as allowable if rewritten in independent form. The limitations in these two claims have essentially now been added to claims 1 and 16 respectively. Claims 1 and 16 are therefore believed to be allowable and claims 3 and 18 have therefore been cancelled.

Claims 1, 2, 5-7, 10-12, 16, 17, 20-22, 25-27, 32, 51 and 56 are rejected under 35 USC 102(b) as being anticipated by U.S. patent 5, 751, 426 to Nose, et al. ("Nose"). The rejection is traversed insofar as it applies to the claims as amended. As noted above, claims 1 and 16 are believed to be allowable and so are the claims upon which they depend, including claims 2, 5-7, 10-12, 16, 17, 20-22, 25-27 and 32. Claims 4, 8, 9, 19, 23, 24, 31, 33 have not been rewritten in independent form, since the claims upon which they depend are also believed to be allowable.

Before the rejection of Claims 37, 45 and 51 is discussed, it is useful first to review the drawbacks of conventional schemes. The paragraph in the present application, page 3, line 16 through page 4, line 15 is reproduced below for the convenience of the examiner:

> Conventional methods for measuring overlay errors employ high numerical aperture objectives for collecting light from two target structures, where high numerical aperture objectives are used to maximize the resolution and hence the edge definition. The target structures may include an inner box at a higher elevation compared to the outer box. Since the collection objective employed in conventional methods has a high numerical aperture, this necessarily means that it has a small depth of focus. Thus, if the objective is positioned so that radiation from the inner box is focused onto the detector, then light collected from the outer box at a lower elevation will be out of focus with respect to the detector. Hence, in order to accurately measure both the inner and outer boxes, it is necessary to measure the target twice, known in the field as "double grab" with different optical focuses, so that radiation from both the inner and outer boxes may be

focused onto the detector. Since two measurements are required instead of one as in a "single grab" measurement, this adversely affects throughput and is disadvantageous. Furthermore, where the detection system is subject to vibrations, such as in a wafer processing environment, vibrations may cause the optical alignment to shift between the two measurements, which may result in errors in the overlay error measurement. According to another aspect of the invention, the collection objective has a medium numerical aperture and therefore a larger depth of focus. Hence this increases the likelihood that radiation from both the inner and outer boxes or other structures at different elevations will be adequately focused onto corresponding detectors simultaneously so that there is no need to measure the target twice. Therefore, there are more applications where single grab is possible so that throughput is not adversely affected for such applications. Furthermore, since a medium numerical aperture increases the odds for adequate information to be obtained for overlay error measurement in one measurement, the system is robust and less affected by vibrations.

Claims 37, 45 and 51 have been amended to clarify the invention covered. In these claims, misalignment is detected between two structures that are on different planes. Optics is used to collect radiation scattered by the two structures and direct such collected radiation to a detector array with one or more detectors. Since the two structures that are on different planes, they will be at different distances from the optics. Thus, the depth of focus is an issue that needs to be contended with. Conventional schemes typically employ high numerical aperture objectives for increased resolution. This means that it is then necessary to measure the target twice, known in the field as "double grab" with different optical focuses, so that radiation from both portions of the target at different distances from the detector array may be focused onto the detector array because of the small depth of focus. This is highly undesirable since vibrations may have caused relative motion between the two portions of the target which increases the chance of measurement errors. The system of claims 37, 45 and 51 have no such disadvantages. Since the numerical aperture of the optics employed is in the medium range, it is possible to measure at both adequate depth of focus and resolution, so that a single measurement suffices.

Nose is totally silent with respect to the issues above. It fails to disclose any range of values for the numerical aperture employed for its collection optics. Furthermore, the two alignment patterns measured (2a, 2b in Fig. 2) are on the same plane. This is described, for example, in column 1, lines 33-43, column 2, lines 19-21

and column 4, lines 13-16. Hence, unlike the situation in the system of the rejected claims there is no requirement that collection optics have to collect scattering from patterns at different distances from the optics. Therefore, as in most conventional misalignment detection schemes, one skilled in the art would expect that such a system would employ collection optics have a high numerical aperture for increased resolution, since employing a reduced numerical aperture would simply reduce the measurement resolution without any benefits.

The examiner rejected claim 51 under 35 USC 102(b) as being anticipated by U.S. patent 5, 751, 426 to Nose, et al. ("Nose"). It is believed to be well-settled that in order for a reference to anticipate a claim, there must be identity of elements between the elements of the claim and those of the reference. Nose clearly fails this test. Since Nose has failed to disclose the above features of claim 51, there is no identity of elements between claim 51 and Nose. As noted above, Nose is totally silent in regard to the issues concerning the fact that the portions of the target measured are on different planes and at different distances from the collection optics, and the issues of the depth of focus and numerical apertures. In view of the vast differences between the above-described differences between the system of the rejected claim 51 on the one hand and Nose on the other, it is believed that there is no reason or motivation to alter Nose's system so as to arrive at the invention of these rejected claim. Therefore, it is further believed that claim 51 is non-obvious over Nose.

Claim 56 is believed to be allowable since it depends upon claim 51. The indication that claims 57-60 and 62-63 would be allowable if rewritten in independent form is noted with appreciation. This has not been done since claim 51 upon which they depend is also believed to be allowable.

Claims 28-30 and 52-54 are rejected are rejected under 35 U.S.C. 103a as being unpatentable over Nose. These claims are believed to be allowable since they depend upon claim allowable claims. They are further believed to be allowable since they add limitations which are not taught or suggested by Nose. These claims add more specific range of values for the numerical aperture of the collection optics. As noted above, Nose is totally silent on the various considerations involved with the numerical aperture of the collection optics. One skilled in the art would expect that Nose's system would employ

collection optics have a numerical aperture higher than those claimed in these claims for increased resolution, since employing a reduced numerical aperture would simply reduce the measurement resolution without any benefits. Thus, if anything, Nose appears to teach away from the features in these claims. The reason on page 4 of the action given by the examiner "obvious to one skilled in the art ... to use a refractive element with the claimed numerical aperture as a means to ensure that the structures are sufficiently resolved" does not appear to make sense in this context. As noted above, since Nose's targets are on the same plane, to one skilled in the art, "to ensure that the structures are sufficiently resolved" actually would mean employing a numerical aperture that is higher than those claimed, especially in view of the fact that there is no benefit to use collection optics with a lower numerical aperture, such as those in the rejected claims.

Claims 37, 40 and 45 are rejected under 35 U.S.C. 103a as being unpatentable over by U.S. Patent 5,808,742 to Everett et al. The rejection is respectfully traversed as applied to the claims as amended. Claims 37 and 45 have been amended substantially in the same manner as claims 1 and 51 in the previous amendment mailed on April 23, 2004. For the same reasons as those discussed in such amendment, claims 37 and 45 are now believed to be non-obvious over Everett et al. Furthermore, since Everett contemplates that his device uses x-rays (e.g. see Col. 5, lines 21-25), the numerical aperture is typically not an important issue for the device to have a large depth of focus (in view of the large gap between the mask and the substrate), unlike the invention in the rejected claims. Therefore, contrary to the reasoning of the examiner, it would not be obvious to one skilled in the art to adopt the values for the numerical aperture in the rejected claims in view of Everett. This is explained in the previous amendment mailed on April 23, 2004 in regard to the more specific ranges of the numerical aperture values in claims 38, 39, 46 and 47. Claim 40 is believed to be allowable since it depends upon claim 37.

As for claims 38, 39, 46 and 47, the examiner has failed to respond to our arguments in the July 2004 office action and simply repeated her arguments from the January 2004 office action. Therefore, if the rejection of these claims is maintained in the next action, the next action should not be a final action, and the examiner is specifically requested to address this issue. For the same reasons as those above for

claims 37 and 45, claims 38, 39, 46 and 47 are believed to be allowable since they add limitations which are not taught or suggested by Everett et al. They are further believed to be allowable since they depend from allowable claims.

New claims 144-175 have been added. They differentiate from Everett et al. for the same reasons as those above for claims 37 and 45. In claims 144 and 156, radiation from the two structures are imaged onto the detectors, where the images formed are exemplified by those shown in the embodiment in Fig. 3B of the present application. They differentiate from Nose on the ground that Nose discloses an interferometer system, where the light scattered by each of the two patterns are from two beams of different frequencies and the diffracted light from the two beams interfere to yield a heterodyne signal from each of the two structures, which signals are then detected by detectors. Thus Nose does not project images of the two structures on the detectors, but rather interference signals from two different beams of different frequencies onto the detectors. As illustrated in Fig. 11 of Nose, the grating lines of the two patterns are not resolved at all in the heterodyne interference signals shown in the figure (from two interfering beams of different frequencies detected by the detectors), so that the outlines of the two patterns in Fig. 11 are not real images of the two patterns. Claims 145-155 and 157-173 are believed to be allowable since they depend from allowable claims, and for reasons similar to those discussed above for claims containing similar limitations. Claims 174-175 differentiate from Nose in that radiation from the two structures are imaged onto the detectors, and the misalignment is determined from the images of the two structures, without requiring any interference effects.

Claims 1, 2, 4-12, 14-17, 19-33, 35-60, 62, 63 and 144-175 are presently pending in the application. Reconsideration of your rejections is respectfully requested and an early indication of the allowability of all the claims is earnestly solicited.

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I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope address to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on October 14, 2004.

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Respectfully submitted,

James S. Hsue — Date 10/14/04

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